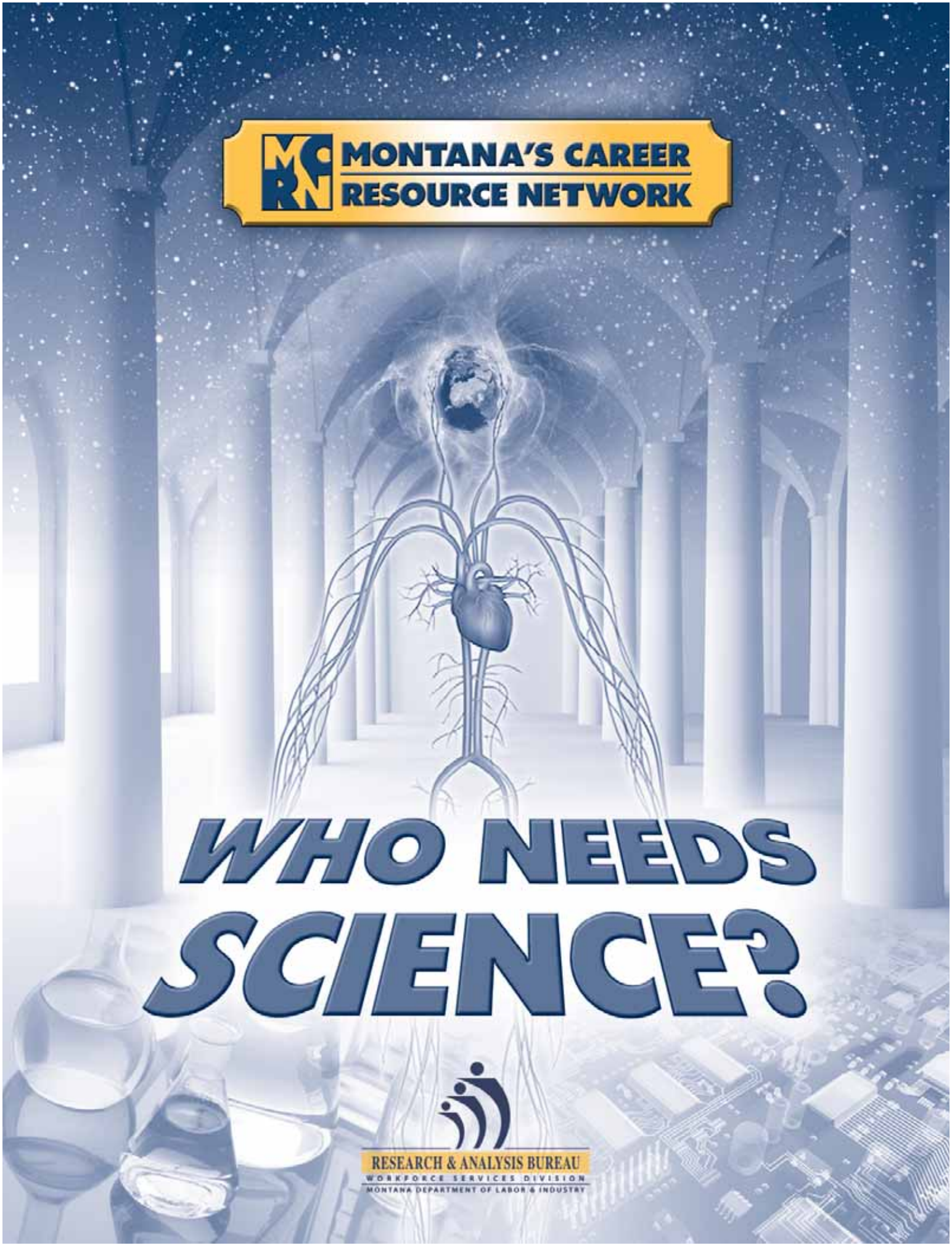
MONTANA'S CAREER
RESOURCE NETWORK
WHO NEEDS
SCIENCE?
RESEARCH & ANALYSIS BUREAU
WORKFORCE SERVICES DIVISION
MONTANA DEPARTMENT OF LABOR & INDUSTRY

WHO NEEDS SCIENCE?

State of Montana
Brian Schweitzer, Governor

Montana Department of Labor and Industry
Keith Kelly, Commissioner

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Read This Publication If...

- **You hate science classes**
- **You are barely passing science**
- **You aren’t going to college**
- **You are going to college but for a non-science related program**
- **Your parents were poor in science**
- **You think you will never need science in real life**
- **You want to learn about some exciting careers**

Who Needs Science?

There's hardly a student who has made it through a high school chemistry class without asking,

"When am I ever going to use this stuff in real life?"

This publication is intended to answer precisely that question.

What you'll find within these pages is a collection of interviews with real professionals in a wide variety of occupations, all of whom use science regularly. As you read, you'll see that science turns up in some surprising places. Want to be a welder? Better not skimp on those chemistry and physics classes. What about a fitness trainer? You'll need a background in both biology and chemistry to understand how exercise and nutrition affects the body. Simply put: science is everywhere!

Twenty-first century jobs rely heavily on math and science, yet U.S. companies have trouble finding enough workers with sufficient math and science skills to fill all their technology positions. As a result, they must seek highly skilled workers from other countries. Most experts predict that today's U.S. students will face stiff competition with foreign workers for American jobs.

Perhaps you've already chosen a career path and you know you'll never need science. Don't be so sure. Athletes and coaches who understand basic laws of physics (like momentum, equilibrium, velocity, kinetic energy, center of gravity, projectile motion, and friction) gain an edge on their competition. Journalists with a background in science have more options in the types of stories they can cover. Some of the most exciting and important news stories involve medical breakthroughs, the environment, new discoveries, controversial research findings,

natural disasters, and other subjects dealing with science. Reporters who have a background in science can grasp technical issues quickly and communicate effectively with researchers, giving them a competitive edge over reporters with a more limited education in science.[1]

Even if you're certain your chosen career does not require science, what happens if you change your mind? Taking advanced science classes in high school helps you keep your options open. If you haven't taken enough science in high school, you may not gain admittance to certain colleges or programs. Why limit yourself by taking only the minimal requirements?

People who never use science in their jobs can still benefit from science education. After all, science is simply a way to understand the world around us– from huge cosmic questions about the origin of the universe, to everyday decisions about whether or not to buy the low carb chips. We encounter scientific principles every day, and the more we understand about science, the better equipped we are to make everyday decisions, and to solve everyday problems. Understanding science can help you in a thousand small ways that you don't even imagine.

Also, jobs that require scientific knowledge usually pay well. Students who major in engineering, physics, health care, and computer science qualify for jobs that consistently rank among the top-earning occupations. Science occupations are some of the most exciting and important jobs out there. Intrigued yet? Then read on.

[1] *"Physics is for You" - American Institute of Physics, www.physics.purdue.edu/career/physics_is_for_you.pdf*

Going to College? Be Prepared.

For admission in the Montana University System (MUS), minimum core requirements include two years of lab science, one of which must be Earth Science, Biology, Chemistry or Physics. Students graduating in 2010 or later will need to complete the "Rigorous Core," to qualify for MUS Honors Scholarships. The rigorous core requires a full year of each of the following: General, Physical or Earth Science; Biology; and Chemistry or Physics. Many out-of-state and private colleges require three or more years of science just for admission.

Remember, even non-science degrees in the Montana University System require you to complete at least two science courses. If you make an effort to retain what you learn in high school, these classes will seem like review. If not, you'll have to relearn everything, but at a much faster pace.

Worried about those admissions exams? Take an academic practice test from MCIS!
Practice tests include the SAT, ACT, PSAT, GED, ASVAB, & CLEP.
Go to: www.mtcis.intocareers.org Username: visitor Password: visitor06

Aviation Mechanic

Rena Smith

Aviation mechanics regularly service, repair aircraft, and perform routine maintenance and inspections. The Federal Aviation Administration (FAA) requires regular checks to be made to aircraft. Mechanics follow the FAA's maintenance plan. They may also inspect aircraft after they have flown a certain number of hours, days, or cycles of operation. Many aviation mechanics work only on preventive maintenance. They inspect the engines, landing gear, instruments, pressurized sections, and accessories. Mechanics who specialize in repair rely on pilots' descriptions to find and fix faulty equipment. Some listen to the engines to identify the problem. Others may use blueprints to learn where repairs need to be done. After completing the repairs, mechanics run tests to make sure the systems or parts are working properly. Mechanics may work on one or many types of aircraft. These may include jets, propeller-driven airplanes, and helicopters. Mechanics may also work for many different types of employers such as: general aviation, corporate aviation, a charter service, or large commercial airlines. Aviation mechanics are more likely to be specialized if they work for commercial airlines and more likely to generalize if they work for a general aviation company.

How did you become an aviation mechanic?

I started my on-the-job training as a helicopter mechanic when I enlisted in the U.S. Army. After two years in the Army, I enrolled in the Aviation program at the Helena College of Technology. After completing the two-year program, I tested for and successfully passed the Airframe & Power plant certification. This certification is issued by the FAA and is required for all civilian aviation mechanics.

What do you enjoy most about your job?

I love aviation, and take great pride in the fact that it is my responsibility to ensure that the planes that I work on remain safe while operating in the air. I fixed it, they are my responsibility.

Is science important in the aviation industry?

Science is key to understanding the principles behind aviation maintenance and technology. The basic understanding of the principles of physics is necessary in order to possess the knowledge necessary to work in aviation. Mechanics must have a basic understanding of aerodynamics, impacts of gravity, and basic equations that concern motion or velocity. Technical math or how to apply basic principles of math are vital competencies needed for problem solving in aviation maintenance. Measurements, calibrations, and math equations are used on a daily basis in an aviation shop.

How will aviation mechanics and their workplace be different 10 years from now?

Future aviation mechanics will need to have more training in the usage of computers to diagnose the more technical engines of the future. They will need to be able to use several different software programs in the process of doing their everyday job. Currently, students that have a good understanding of Windows applications are already a big step ahead.

Bridge Engineer

Stephanie Brandenberger, P.E.

Stephanie Brandenberger is a structural engineer who designs bridges for the Montana Department of Transportation. Whether it is a big highway bridge or a small bridge over a creek, it has to be safe for drivers and must withstand all kinds of forces, such as heavy trucks, high winds, floods, earthquakes and impacts from trains. Bridges also have to look nice and fit into the surroundings. They have to accommodate the needs of the public driving on it, as well as the environment around it. No two bridges are exactly alike, so Stephanie faces new challenges with every project she works on.

What exactly do you do?

First, I get an idea about how the bridge will be used, what it should look like, and how it will be constructed. I gather information on traffic, soils, and the environment around the bridge. I use math and physics to determine the forces on a bridge and how it will behave under these forces. Will it sway too much? Will it crack? This part is called "analysis" and is a big part of my job. Then I draw the bridge plans and all the pieces that make up the bridge, so someone can build it.

What's your favorite part?

Engineering is a lot like putting a puzzle together. I take pieces of information and fit them together and create something unique and helpful to a community. I like thinking of new ways to solve problems.

How has your job changed over time?

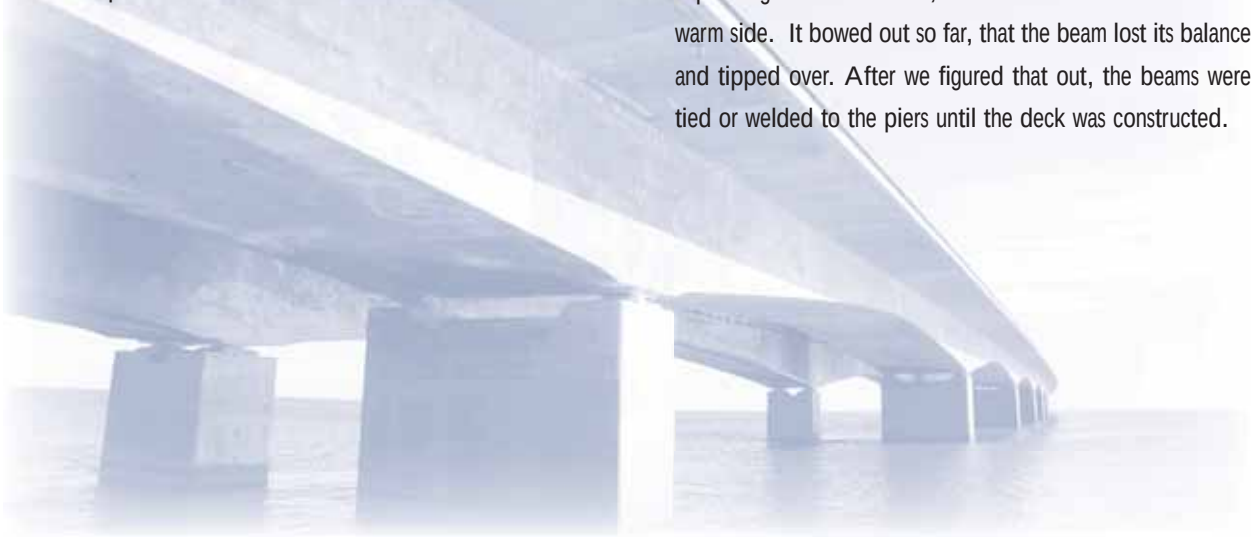
Computers have allowed engineers to analyze and design more complex systems, resulting in bigger, longer, taller, and more elegant structures than ever before.

How do people react when they learn what you do?

They want to know why things are built the way they are. I like answering their questions and helping them understand and appreciate all the great things they use every day that engineers had a part in creating.

Tell me a story about something odd that happened at work.

Sometimes, an engineer's job is about solving mysteries! Once on a construction site, a 6-foot tall, 145-foot beam that weighed 57 tons had just been set on piers. The workers went home for the night, and came back the next day to find the beam had fallen into the river! There was no wind and no earthquake to push it off. Why did it fall in the river? When concrete gets cold it shrinks a little, when it gets warm it expands a little. The morning after the beam was set, the sun came up and started heating up one side of the beam. That side started to expand. The other side was in the shade and was still cold. Since the two sides of the beam were not expanding at the same rate, the beam bowed out toward the warm side. It bowed out so far, that the beam lost its balance and tipped over. After we figured that out, the beams were tied or welded to the piers until the deck was constructed.



Chemist

Angela Belcher, Ph.D.

"I have the best job in the world," declares chemist Dr. Angela Belcher, a professor at the Massachusetts Institute of Technology (MIT). When she's not teaching, she gets to practice pure science–conducting experiments and developing theories. Her work has caught the attention of scientists and computer technology experts worldwide. She has figured out how to use genetically modified viruses to produce super-small "nanomaterials" such as nanowires and self-assembling films. Her techniques may one day help manufacturers to build nanoscale integrated circuits and other microscopic electronic components efficiently and cost-effectively.[1]

The idea to combine nature with human-made technology came about because, like most creative people, Angela doesn't limit herself to one subject. While getting her Ph.D., she studied how oysters make pearls. She even grew her own (flat!) pearls in the lab. Later, she did work relating to electrical engineering–a completely different field. Her research combines those two areas–making a connection that others hadn't considered. Angela says that science is for people who are "creative, curious, dreamers." She definitely falls into those categories. "Sometimes I can't sleep because I have so many ideas," she admits. Someday, those ideas might change technology as we know it. The following interview was conducted when Angela was an assistant professor at the University of Texas at Austin.

What exactly do you do?

First, I teach undergraduates (college students who haven't graduated yet) from all majors, and grad students (graduates pursuing advanced degrees) in chemistry and engineering. This part of my job includes developing lesson plans, overseeing teaching assistants, and holding office hours.

Second, I'm an advisor of Ph.D. and master's students as they work on their dissertations (major research projects). I oversee their work and guide them.

In addition, I conduct original research, which is a lot like running my own business. It includes deciding what to study, writing grants to get funding, supervising the researchers (my grad students), writing papers about the results, presenting the results at conferences, and doing a lot of "on-my-feet" problem-solving.

Finally, I consult with private companies. They ask me questions about my research and I give my opinion on ideas that they have. It's fun and it pays well, although it requires a lot of travel.

What's the coolest part of your job?

I get to travel all over the world. Also, I get to use sophisticated equipment that few others do.

[1] *Source: "MIT researcher Angela Belcher named 2004 MacArthur Fellow," www.smalltimes.com*

What's your favorite part?

I can study whatever I want, as long as I get the funding. I can pretty much set my own hours. Also, I get to work with others who are interested in science. I get to prove myself to my specific science community, enjoy a friendly competition, and help push science forward.

Tell a story about problem solving in your job.

To successfully use viruses on computer chips, we need to be able to control them. In the body, small strands on the surface of viruses let them identify and bind to specific cells. We needed to know if they would bind to specific semiconductor chip crystals in the same way.

We found out by putting millions and millions of the viruses into solutions with various semiconductor crystals.We washed away the viruses that didn't bind strongly to any crystals. Then we identified the viruses that targeted only specific types of crystal. We found that some were so selective that they could tell the differences between two almost identical crystals. That's really good news for our research.

How did you get into this profession?

At age 12, I wanted to be a medical doctor. I read medical books and attended rounds (reviews of patients) at Rice University hospital when I was in high school. When I was in college, though, I realized that I really liked molecules, so I got into chemistry.

What's the next step on your career path?

I want to learn a completely new field every five years, so who knows where I'll go?

Any advice for students entering high school?

You don't have to be perfect. You need to get certain grades to clear barriers, but don't get so hung up on grades that you lose balance. Don't be afraid of making mistakes; just learn from them.

The Job in Brief...

Title:	Professor/Chemist
Travel:	I travel frequently (about once a week) to attend conventions and consult with private companies.
Hours:	over 80 per week (by choice)
Education:	Bachelors of Science in Molecular Biology/Biochemistry Ph.D. in Solid State Chemistry
Science:	I use it every day.

For more information on this career:

www.chemistry.org/portal/a/c/s/l/educatorsandstudents.html

Cosmetologist

Linda Pouliot

What exactly do you do?

I cut, style, color highlight, and perm hair. I also arch eyebrows (we pluck chickens), apply artificial nails, perform manicures, pedicures, facials and massages. As far as personal customer service goes, I boost people's morale and self esteem, encourage changes to their self image, teach aftercare techniques, and shower them with T.L.C.

What's the coolest part of your job?

Boosting people's self image and one-on-one friendships. When your hair is "right" all is well in your world. I can make them feel so much better about themselves.

What's your favorite part?

I enjoy analyzing people's hairstyle to fit their features and to fit their life-style. Drastic changes are very fun!

Tell a story about problem solving in your job.

If a person hates to fix their hair, then for goodness sakes, give them a "carefree" cut. If they make a mistake at home on their own hair, we can correct it. If their problems are personal, really listen and brainstorm for solutions with them (if they ask for your input).

Describe a funny story that happened on the job.

At beauty college, after many practice hours, my first customer knew me AND my family. YIKES! Sooo, I intentionally took a very long time to cut, roller-set, and comb out her hair (3 hours), so it would be PERFECT. Well, a year later she was assigned to me at the salon where I was working. She took one look at me and said "Oh my Gosh, I DO hope you are FASTER than you used to be!"

How did you become a Cosmetologist?

I always loved "playing" with hair. I did my sisters', my friends', and "creative up hairdos" on myself from a very early age. Also, there was a funeral home close to my house when I was growing up. A friend and I used to sneak in there and see how awful the dead person's hair looked. We knew THEN that we can't be morticians. However, later we decided we wanted to work with "live" people. Now, I just want to make people beautiful "dead or alive."

What surprised you about your job when you first started?

I was surprised at how very challenging it is to work with the public, their moods and attitudes. You need to be patient with some who are very "picky" and hard to please. You need to be a good communicator and learn to know the difference between whether to talk or just listen to your customers. LEAVE YOUR OWN PROBLEMS AT HOME!

How has your job changed over time?

I have followed trend releases (new releases) twice a year for 30 years. Trends have gone from razor cuts to scissor cuts, and from "huge" hair, to no hair, to spiked hair. Coloring hair has changed from normal to "funky."

Any advice for students entering high school?

You must graduate from high school, or have your GED to be accepted to cosmetology school. I would advise you to work on your social skills and take sociology courses. You have to be able to get along with personalities that you don't like. You must accept people for WHO and HOW they are.

The Job in Brief...

Title: Cosmetologist

Travel: You travel to state and national conventions yearly or twice a year. If you have a customer who is sick or home bound, you need to go to their home.

Hours: I work Monday through Friday, 40 hours a week. In the beginning of your career, you need to work week days, evenings, and weekends to build up your clientele.

Education: High school diploma or GED and one year of cosmetology school. You will need to attend hair shows once or twice a year for your whole career.

Science: A working knowledge of chemistry is necessary. You need apply basic concepts like acidity and ph balance to understand the possible results of using the ingredients in all of the products you apply to people's hair, head, and skin.

Diesel Mechanic

Ralph Rinehart

Diesel mechanics repair machines used in construction, logging, or any other heavy equipment that has a diesel engine. They maintain equipment so that it operates properly and safely. When equipment breaks down, they examine it for defects. Mechanics often use computerized diagnostic hand-held computers to diagnose components that need repair. They may take the equipment apart to inspect or repair various parts. Sometimes they use jacks or hoists to lift or move large parts. It is of utmost importance for most owners of diesel equipment to keep them running properly. For this reason, most diesel mechanics get the opportunity to work a great deal of overtime. Breakdowns of equipment are almost never expected, but always seem to happen when you are least expecting it. All diesel mechanics are expected to own their own hand tools when they start in the trade and continue to add to them as they gain experience. A mechanic beginning in the profession may own only $2,000 in hand tools, while a diesel mechanic with several more years of experience may own up to $20,000 in hand tools.

How did you become a diesel mechanic?

While growing up in Montana, I was always very active in working for the family logging business. We owned diesel trucks, crawlers, and other diesel equipment that I was held responsible for keeping in good working order. I learned a lot about mechanics from my dad and was able to complete my first diesel overhaul by the age of 14. After graduating from high school, the family business was sold due to a declining lumber industry. I went to Denver where I worked road construction for one year, then moved to Portland where I worked on the city's first pillared highway project. One year later, I came back to Butte and started my career in diesel mechanics working for Robert's Rocky Mountain Diesel. There, I enrolled in a 4-year apprenticeship program that only took a little over 2 years to complete, due to my prior work experience in diesel maintenance. I was then promoted to a Field Service Tech and made a journeyman level wage while traveling and dealing with large corporate diesel accounts.

What do you enjoy most about your job?

I most enjoy the interactions with my customers on the job. Most of my customers are repeat business and ask for me in person when they need their diesel worked on. I enjoy the recognition that I receive from them and the trust that they have in my work.

Are math and science important in the diesel industry?

Math and science are key competencies that a diesel mechanic must have in today's workplace. The basic understanding of the principles of physics is necessary in order to understand how to solve problems in the diesel trade. Basic math, technical math, and geometry are also subjects that must be mastered before one can fully understand the principles of diesel mechanics. Measurements, ratios, fractions, and metric to American standard conversions are common calculations that need to be made everyday in the workplace.

How will diesel mechanics and their workplace be different 10 years from now?

Future diesel mechanics will need to have more training in the usage of computers. They will need to be able to use several different software programs in the process of doing their everyday job. Currently, students that have a good understanding of Windows applications are a big step ahead of students with no computer understanding. The future diesel garage will be a much safer work environment due to the help of hydraulic machinery for heavy lifting and the increased attention put on the prevention of industrial accidents.

Fitness Trainer

Stephanie Younkin

What exactly do you do?

I am a personal fitness trainer. I assist people in many aspects of their personal fitness program. I assess fitness levels; assign, instruct, and monitor the performance of various exercises; and advise on elements of proper nutrition for optimum fitness; all based on the individual's personal goals.

What's the coolest part of your job?

By far, the coolest part is watching folks achieve their goals. Watching an individual finish a 5K run when months earlier they would have had to walk the same course is a great feeling. Knowing that I was able to give of my own knowledge and let them pursue their goals safely and successfully is extremely rewarding.

How do you use science in your job?

Science figures predominantly in all aspects of my job. Personal training and exercise is no longer handled with a "trial and error" approach. To safely and successfully lead a client through a fitness program requires an understanding of anatomy and physiology, and the science behind various nutritional methodologies. My certification process required a tremendous amount of study to understand the physiological responses the human body has to exercise-induced stress.

Tell a story about problem-solving in your job.

It is a common problem: A client approaches me with a complaint of joint, muscle, or connective tissue pain. By studying the client's fitness history and current routine, and applying my knowledge of how the body's joints, muscles, and connective tissues interact, I am able to identify and correct improper form and/or frequency, or prescribe recuperative and preventative exercises to ensure they are able to exercise injury-free.

How did you become a fitness trainer?

My prior career was nursing, so my educational background already included study on anatomy and physiology, biology, and other science-related courses which helped my understand the human body as the complex system it is. Early in my adult life, I rediscovered my passion for exercise. Eventually, I realized that I could combine my passion with my educational background and re-establish myself in a new career as a personal trainer.

How has your job changed over time?

In my line of work, approaches and methodologies are always being re-evaluated and modified, based on personal experience and advanced research. New twists on old exercises are always appearing. I must use my own knowledge of the science of the human body to distinguish between a "fad" and a legitimate modification to an established way of thinking. The health and safety of my clients depends on my ability to do that.

What will fitness trainers be doing differently ten years from now?

Although people have been exercising for decades, a focused scientific approach to understanding how the human body reacts to exercise has only occurred in the last couple of decades. Therefore, we are still working to build this understanding. In the future, fitness trainers will need to continue to build their scientific health-related knowledge in order to understand and apply the results of new research.

Any advice for students entering high school?

Do not discount any classes as being unnecessary. You never know when the opportunity will arise to use those classes in your current career or a new career. Be ready for that opportunity.

Forensic Scientist

Gary Molina

"DNA Test Reveals Prisoner's Innocence." You've probably read headlines like this, but what does it mean? We asked Gary Molina, a forensic scientist who tests DNA for the Texas Department of Public Safety ("Forensic"means related to the legal system). Because of Gary and others like him, the justice system has convicted many guilty people to jail and freed some innocent ones. These days, scientists are more important in solving crimes than ever before.

DNA–Deoxyribonucleic Acid, the substance that makes up your genes–decides what you look like and more.This "blueprint for you" resides in the center, or nucleus, of almost every cell in your body. No two people (except identical twins) have exactly the same DNA.

Forensic scientists use DNA tests to identify a pattern or "profile" of DNA left at a crime scene. They can get it from blood, saliva, skin, hair--almost anything the criminal left behind. By comparing this "DNA fingerprint" with the DNA of a suspect, scientists can tell the likelihood of the suspect's being at the scene.

We interviewed Gary in his office and lab in downtown Austin. He shares the building with the famous Texas Rangers, and often assists on their cases. Posters line the hallway walls, describing how DNA helped solve some famous Texas crimes.

Despite the good DNA testing can do, it can be stressful. There's no room for mistakes. But when work seems hard, "I remind myself of the job's importance and how it helps victims," Gary says. If, like Gary, you enjoy science and want to fight crime, forensic science might be the job for you!

What exactly do you do?

My work falls into three categories. First, I test evidence DNA here in the lab. Then I write a report of the findings. Second, if the case goes to trial, I may testify about the results. Finally, sometimes, when a crime occurs in a small town that doesn't have its own lab, we go there in our mobile lab and take evidence at the actual crime scene. Usually, though, the investigators bring the evidence to us.

What's the coolest part of your job?

Helping to solve crime.

What's your favorite part?

I get to combine two of my interests: public service and science.

How has your job changed over time?

New techniques have changed it a lot. In 1992, when I started, all we could do was identify blood type and some proteins from blood samples. Now, with DNA testing, we can get a lot more information and not just from blood.

How do people react when they learn what you do?

They're very interested and want to hear stories.

Tell me a story about something odd that happened at work.

You can find unexpected items at crime scenes. In one case, the murder suspect was wearing jeans with a "Not Guilty" brand label on the back. But the jeans had the victim's blood on them, so it was pretty clear that the suspect was guilty. I keep a photo of that bloodstained brand because it's so bizarre.

Tell me a story about solving some problem at work.

I'm currently working on a case where the only evidence is a piece of chewed gum left at the crime scene. The problem is how to get the DNA out of it. I think I'll be able to do it by freezing the sample and swabbing it to get some residue of saliva left on the gum. Another time, we had to identify a skeleton. We did it by getting DNA from the center of one of the teeth.

How did you become a forensic scientist?

I was always interested in science. I liked my science classes in school, particularly the labs. I worked in a lab during college and then in a hospital lab afterwards. One day, I saw an ad for this position and got hired.

Where will the job of forensic scientist be ten years from now?

I think the public will know more about DNA testing. More people will enter the field and that will increase competition for jobs. There probably won't be as many advances in DNA testing as there have been in the last ten years, but we'll be able to collect DNA from even more places than we can today.

What's the next step in your career path?

I like what I do now. Eventually, I'd like to move into management, though the competition for manager jobs is fierce.

Any advice for students entering high school?

Enjoy your science classes but don't focus only on science. And keep an open mind about what you want to do. What you end up doing, and loving, might be different from what you originally had in mind.

The Job in Brief...

Title: Forensic Scientist

Travel: Some travel for court, investigations, and conferences.

Hours: 40 per week, but I'm always on call (usually called just 3 times a year)

Education. Bachelors of Arts in Biology

Science: I use it every day, it's what I do.

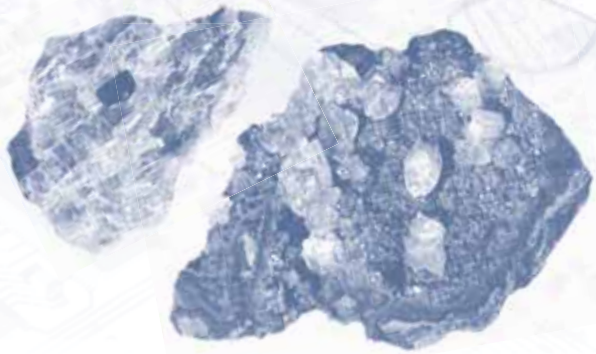
For more information go to:

www.forensic-science-society.org

www.forensicsciencesfoundation.org/career_paths/careers.htm

Geologist

Kitty Miliken, Ph.D.



Her neighbor calls her "the mud lady," but Dr. Kitty Milliken does more than play in the dirt. She's a geologist–a scientist who studies the earth. Geologists can investigate many things about the earth–both big and small, outdoors and inside. Some work "in the field," for instance, mapping the distribution of different kinds of rock. Kitty spends most of her time at the computer or the microscope. She studies tiny samples of mud and rocks to learn about the history of chemical reactions recorded there. "I'm still studying samples from the ocean floor I collected back in 1993," she says.

Studying rocks under a microscope might seem like an odd job at first, but Kitty's work has practical uses. You may not realize it, but rocks have tiny pores, like the pores on your skin, which contain oil, gas, water, and sometimes microscopic life. "For that reason, oil companies sometimes fund my research. They're always trying to understand where to find pores in rocks," Kitty explains.

Kitty obviously loves all aspects of her job. Her main source of stress, she says, is "I keep choosing too many fun things to work on at the same time." That's the kind of "problem" most people would love to have at work.

What exactly do you do?

My main job responsibility is research. I think of questions, then try to find the answers. I try to get someone (usually a government agency) to help fund the study, and afterwards, I spread the news by publishing papers and giving presentations to other geologists. I also help to maintain the lab, keep the machines running, and make sure that the sign-up system works smoothly for all the students. Finally, I help supervise grad students (students seeking advanced degrees) and teach a course on how to use certain equipment.

What are you researching now?

I currently have a couple of projects. I'm studying carbonate cements (mineral-clogged pores) in gas reservoirs in a Rocky Mountain basin. In addition, I'm studying products of bacteria in rocks' pores. Geologists are beginning to realize that bacteria inhabit pores in rocks in an amazing variety of places, even miles deep in the ground. I'm trying to learn better ways of identifying the effects of such bacterial communities, both the tiny fossils they leave behind and the chemicals they produce in rocks.

What's the coolest part of your job?

I get to study nature and, on a really tiny scale, go exploring. Using the electron microscope, for instance, there is always the possibility of seeing something really new, something no one else has seen before.

What's your favorite part?

I like defending papers. Before a journal publishes a scientific paper, many other scientists review it to make sure that the study is sound and contributes something new. Sometimes they raise questions and you have to defend your work--your methods or conclusions and so on. I really enjoy that process. It's a fun sort of challenge and having a paper published in the end is very satisfying.

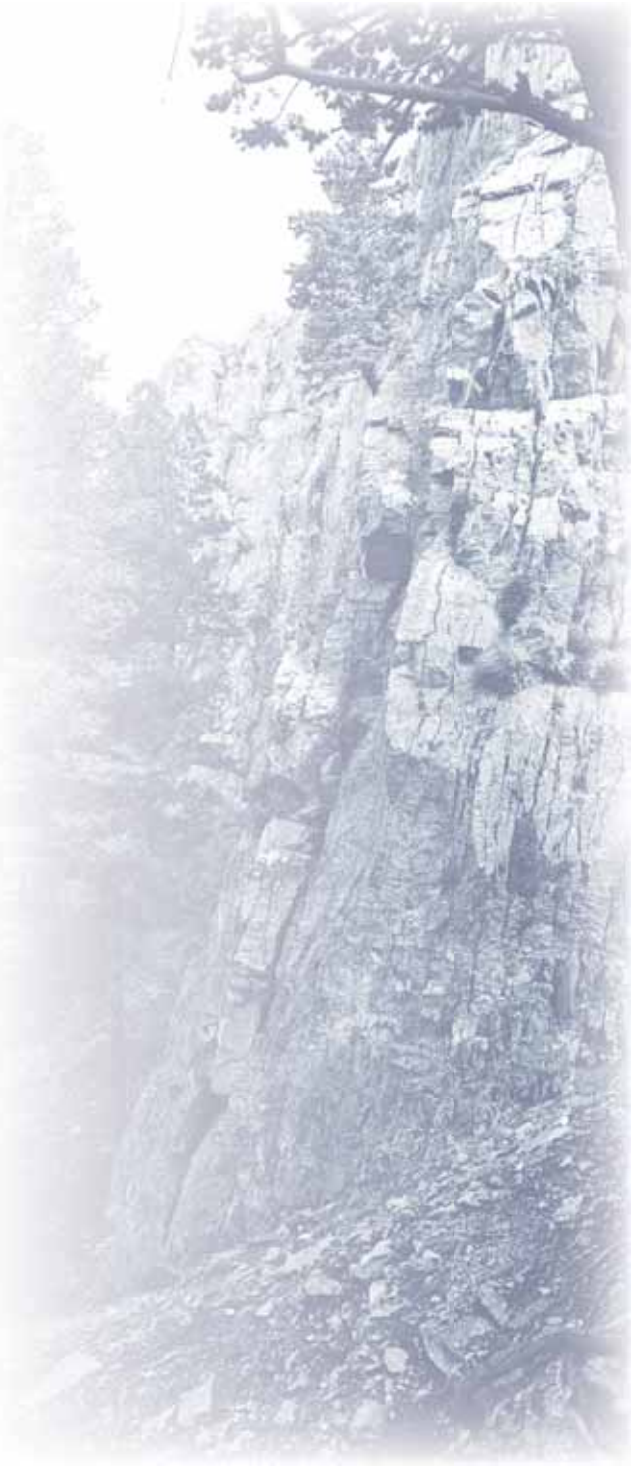
Describe a funny incident at work.

Once I was at a geological conference where I met some of my European colleagues for the first time. They were surprised to learn that I was a woman! I'd always published using my first initials only, so they had no idea even though we'd known each other's work for years.

How did you become a geologist?

I began collecting rocks when I was around seven years old. I grew up in southern Kentucky, which has abundant chert nodules. These lumps of minerals weather out of the limestones

and have bizarre and interesting shapes. I collected these, then started picking up other kinds of rocks as well. I read books about rocks and my parents were willing to take me on field trips and find space for my rock collection which grew to be quite large. By the time I was in high school, I knew that I would be a geologist. In fact, eventually, I did my master's thesis (a really big research paper) on the chert nodules I'd collected as a child.



Tell a story about problem solving in your job.

I once read about 'exploded fossils' in a paper published in 1908. Exploded fossils were believed to form when minerals grow inside a fossil cavity, forcing the fossil apart. Some really small fossils end up growing as large as boulders. When I first read this, it sounded kind of absurd to me. I thought, "No way that could happen! What a silly idea!" Then I actually found some exploded fossils. So I had to believe. By studying thin slices of these trace rocks with a microscope, I was able to show that these rocks, now made of the mineral quartz, were once, long ago, a different mineral called anhydrite. Now things made more sense. Quartz formation isn't likely to cause expansion, but when anhydrite gets wet, it absorbs water readily, changes to a different mineral called gypsum, and increases in volume by about 30 percent.

Any advice for students entering high school?

Take a lot of math. Math is incredibly important in science. I wish I'd taken even more math in college than I did, and I had a math minor! Do your own work in science fairs! Come up with your own ideas. I sometimes judge these fairs and it's clear that parents or teachers sometimes do the work or come up with the ideas. If you find a science subject that you love, take college-level courses when you're in high school. You don't have to actually enroll. Just ask professors if you can sit in on lectures. They'll usually be happy to let you if there's room in the lecture hall. You might not get formal credit but you'll learn a lot. When it comes to choosing a career, find something that gets you excited and don't let anything turn you away from it. A career is something you're going to do for a long time, so do something you think is fun!

The Job in Brief...

Title:	Geologist	Education:	Bachelors of Arts in Geology, Ph.D. in Geology
Travel:	At least two meetings per year.	Science:	Every day, including geology, biology, and paleontology.
Hours:	40 at work, another 10-20 at home		

For more information go to:
www.geo.utexas.edu/careers, www.earthscienceworld.org/careers

Hydraulic Engineer

Mark Goodman

A hydraulic engineer for the Montana Department of Transportation is involved with all aspects of surface runoff. Runoff can originate from small watersheds such as streets and highways or from large watersheds such as the Yellowstone or Missouri River. The hydraulic engineer's duties include determining how much water we need to pass through the highway, which is referred to as a "hydrologic analysis," and what frequency event we should be concerned with. For example, a 10-year flood, 50-year flood, or even a 100-year flood event will need to be analyzed in order to determine how large of pipe or bridge we need to put in the roadway without causing water to "back up" and cause damage to the roadway, upstream property or buildings, and without causing an inconvenience to the traveling public.

Many tools are available to the engineer to perform his job. A hydraulic engineer uses aerial photos, topographic maps, stream gauge data, surveyed cross-sections, and soils data, to name a few of the resources available to help them make good decisions. The computer is also used extensively to design the hydraulic openings required, this is referred to as a "hydraulic analysis." The many different options and alternatives in order to come up with the most cost effective design. This, of course, is the goal of the engineer, to come up with a solution to a problem, to minimize the cost to the public while still providing a safe transportation system and also being environmentally friendly.

What exactly do you do?

A hydraulic engineer's work includes making field reviews of proposed highway projects, collecting the data required to do a hydrologic analysis of drainage crossings, and preparing a report and recommendations for new structures in the proposed highway.

What's the coolest part of your job?

Solving problems related to water and its affect on the transportation system. Also, trying to reproduce flood events with our hydraulic models. My favorite part of the job is developing computer models that mathematically reproduce an event that has occurred in nature, such as a flood.

How do people react when they learn what you do?

They are surprised at the amount of detail involved in sizing something that seems so simple as a culvert.

How has your job changed over time?

Three of the biggest changes are the advent of the personal computer and the availability of computer software to analyze hydrologic and hydraulic events, the attention we pay to the effect of our designs on the environment, and the involvement of the public in the design process.

Tell me a story about something odd that happened at work.

We were trying to determine why the surveyed water surface elevation upstream of one of our bridges was so high during a flood event. We just couldn't get our models to predict such a high water surface elevation. After talking to maintenance folks they told us that a house had actually fallen into the river and became lodged on the bridge. This of course blocked the bridge opening and caused a much higher elevation than we could have ever predicted.

Neuroscientist

Lisa Cain, Ph.D.

"You're getting on my nerves!"

"She's got a lot of nerve!"

"I feel so nervous."

Many people talk about nerves, but Dr. Lisa Cain is an expert. She's a neuroscientist. Neuroscientists study nerve cells, or neurons. Neurons and glia (support cells) run throughout your body, especially your brain and spinal cord. This nervous system handles the communication and control of your body. It detects and explains changes in and outside your body and responds by moving your muscles and releasing chemicals into your blood. It's like your body's own phone system with neurons instead of wires. Sometimes nerve cells get damaged. Your brain may tell your leg to move, for instance, but if your spinal cord is cut, the message can't get through so your muscles don't move. Similarly, if you injure the nerves in your brain, your ability to think and remember may decline.

That's where Lisa comes in. She studies nerve cells to understand their development and function. She also investigates how to repair damaged nerve cells. Someday, her research may help heal people who are paralyzed or can't think as clearly as they once did. Although her work is challenging, Lisa is optimistic. "It's hard to convince me that I can fail. I work hard and I don't give up," she declares. It's clear that Lisa loves her job and the opportunities it brings. "Scientists get paid to think," she says. "With a Ph.D. (the highest educational degree), you can do anything: work in the government, in industry, or in the educational field. You can even start your own business." But getting a Ph.D. doesn't mean you know it all. "You can never stop working, never stop learning, never stop improving," she adds. That attitude explains the success she already enjoys.

What exactly do you do?

Educating, researching, and mentoring. In particular, I'm focusing on a number of areas. I'm trying to find out how to block the chemicals that kill neurons after spinal cord injury. I'm also investigating growth factors or chemicals that may be responsible of AIDs-induced dementia, a disease that produces conditions similar to Alzheimer's disease. Looking at neurons that die in Alzheimer's disease has been my main project. And, although I am not doing work in this area, I am also interested in neuron damage that occurs after a stroke. All of the injuries to the brain that I mentioned have at least one common mechanism that causes the death of neurons. I want to understand the mechanism of neuron death so that I can prevent or reverse the damage.

What's the coolest part of your job?

I teach a human gross anatomy class to the first year medical students, and I have the opportunity to show and teach them about the parts of the human body.

What's your favorite part?

I get to play detective when doing research. I like to look at the whole story and read everything about a subject before I do my own experiments. I try to see what's missing, and then I find the missing piece of the puzzle.

Tell a story about problem solving in your job.

In one experiment, we treated spinal cord cells with a certain amount of a drug. Instead of protecting the cells, it killed all the cells! To find out how much of the drug we could use safely, we had to do a series of tests. We had four or five dishes and gave the cells in each a different amount of the drug. Then we studied the results. That process took a while, but we figured out the correct dosage to use.

How did you become a neuroscientist?

I always liked science. My father was a chemistry teacher who exposed me to the mysteries of science and nature. In addition, reading the history of scientists used to fascinate me. In high school, I became interested in biology. In college, I realized that I loved taking comparative anatomy. In graduate school, I found I enjoyed studying cells and looking at them under a microscope. I am also an artist, so I'm very visual. After I got my doctorate degree, I got into neuroscience, which focuses on a particular type of cell.

What will neuroscientists be doing in ten years?

I think neurobiology will continue to be a very prominent field in research. There's so much left to know. The advancements in the human genome project (which maps out human genes), however, will greatly increase the pace of research.

What's the next step on your career path?

Someday I'd like to be a president of a university. I would also like to influence science and education on an international level, maybe as the head of an international science-related organization.

Any advice for students entering high school?

Be excited and enjoy what you do. Learn to get along with others. I think that personality is as important as academic ability. When you get along with others, you can get from A to B faster. You have to know how to be confident but also humble in order to get ahead. Never run away from a challenge. Don't be afraid to dream, to think. Envision yourself in the grandest state that you desire to be and go after it every day.

The Job in Brief...

Title:	Neuroscientist and Assistant Professor of Anatomy
Travel:	1 big trip a year and possibly smaller trips to speak at other schools.
Hours:	40-70 per week (it's flexible)
Education:	Bachelors of Science in Biology Ph.D. in Anatomy
Science:	All the time.

For more information:
http://faculty.washington.edu/chudler/neurok.html

Polar Meteorologist

Rick Toracinta, Ph.D.*

**Rick Toracinta passed away in November 2005. This interview is included to honor his memory, and to highlight his dedication to advancing scientific knowledge and passing on this knowledge to others.*

Many people worry about global warming, Earth's atmosphere is very slowly heating up. What will happen to plants, animals, and humans if it continues? No one knows for sure, but people like Rick Toracinta dedicated his life to finding out. As a meteorologist, Rick studied the weather of the past and present, and tried to predict what might happen in the future.

Global warming is not new. The Earth's atmosphere has actually been heating up for the past 21,000 years. Before then, giant glaciers covered large areas of the globe. As the planet warmed, the glaciers retreated to the North and South Poles, leaving the land and seas as we know them today. Rick's work involved running and analyzing computer models to simulate Earth's weather 21,000 years ago, and what happened as global warming began. He also worked with other meteorologists to better understand how the weather at the earth's Poles affects the weather elsewhere on the planet. If glaciers at the Poles melted, for instance, how serious would the flooding be and how would it affect the weather? In addition, Rick gave lectures to university students about meteorology, guided "severe weather tours" on the Great Plains, and contributed to the interactive weather section of the educational website www.edheads.org.

What exactly do you do?

First, I help develop and improve a computer model of the earth's atmosphere. Since the atmosphere is like a fluid, you can describe it mathematically and turn that into computer programming. I'm constantly perfecting the model, which means doing actual programming. Developing the model requires me to work with others, such as geologists, glaciologists (people who study glaciers), and meteorologists who specialize in paleoclimatology (the study of the climate in remote geologic eras). They help me make sure that my study is reasonable.

In addition, I actually work with the model, setting up simulations, running them, and analyzing the results. I verify the results by getting actual weather reports from the North and South Poles. Then I try to figure out why the model/simulation did or didn't work.

Finally, I write papers about the results. A study is not very good if others can't benefit from the information gained. Also, publishing allows other people to give you feedback and new ideas.

What's the coolest part of your job?

To get a glimpse of "way back when" even if it's only with a computer model.

What's your favorite part?

Seventy percent of my job is setting up simulations. The neat part is getting the results and then asking new questions: What if we do this? It's like being in a lab, running experiments.

Tell a story about problem solving in your job.

I find problems to solve every day; that's what I do. For example, I'm currently trying to figure out how the climate was 20,000 years ago. A huge ice sheet covered North America instead of the grassland and mountains of today. Ohio, where

I live, was under maybe a half a mile of ice. I have to add that ice sheet to the model. But exactly how tall or deep was it? That's my problem. I'm working with experts in other areas of science to solve it. One colleague can describe how the landscape used to be by observing how the earth is today. He's like a hunter looking for footprints in a forest. He sees deep scour lines on the ocean floor, for example, and knows that a glacier moved across it. I'm also working with a guy who is an expert on glaciers and has an icesheet simulation program. By sharing our expertise, the three of us are coming up with a clearer picture of how the earth used to be. We're helping ourselves as we help each other. That's how we're solving the problem.

How did you become a meteorologist?

I've always been fascinated by weather and storms, even as a kid. My earliest memory is of watching a thunderstorm with my dad. As I got older, I loved watching the Weather Channel. I knew early on that I wanted to be a meteorologist, though I had other interests over the years. Throughout, though, weather was always the continuous thread.

What will polar meteorologists be doing ten years from now?

We will have a much better understanding of climate change and how the Poles relate to that. Today there's so much still unknown. In the future, I think we'll still be using computer simulations but they will improve a great deal.

Any advice for students entering high school?

Learn mathematics and physics; they're the foundation of everything you learn from then on. If the foundation is not solid, what you build on it won't last. If you're interested in something, watch, observe, and learn. Don't just rely on what you get out of a textbook. Find out what you need to study. I regret that I didn't talk to people in the field to find out exactly what classes I needed. My first couple of years in college were extremely difficult because calculus and physics were new to me. They were just review for my classmates who had taken those subjects in high school. My grades were good but I had to work a lot harder than the others.

The Job in Brief...

Title: Polar Meteorologist

Travel: 3-4 times a year I attend conferences in places such as Colorado, Sweden, and Antarctica.

Hours: 50 hours a week.

Education: Bachelors of Science in Meteorology, Masters of Science in Atmospheric Studies, Ph.D. in Atmospheric Studies

Science: I use physics and other sciences. You don't think about it; you just know the concepts and principles. I need to know calculus because it's closely related to physics.

For more information go to: informationwww.nws.noaa.gov (National Weather Service)

Science Teacher

Julie Beaver

What exactly do you do?

I teach biology and chemistry. In order to be effective, I must keep up with current developments in science and organize lessons, labs, and evaluations of my students. I assist with science-related clubs and activities at our school.

What are your daily tasks and decisions?

I have one class of Biology and four Chemistry classes that I teach. I must decide daily how I will present the material we are studying, what labs to do, and if we need to revisit concepts that the students are struggling with. I also have papers to grade just about every day.

What is the coolest part of your job?

I enjoy getting to work with young people and nurturing in them a desire to learn more about the world and how things work.

What is your favorite part?

The people I work with (students and staff) make every day a new adventure, and I love that each day is different!

Describe a funny incident at work.

One year, I had my kids make root beer as a culmination of the cellular respiration unit. I went to open one bottle (it was too big a bottle, I now know) and there was so much carbon dioxide that it exploded all over me and the lab bench. It scared me to no end, but my kids sure thought it was funny!

How did you become a science teacher?

I have always loved the sciences and biology was definitely what I wanted to study when I left high school. Both of my parents are in the education field and I would have to say that their influence was probably the largest factor in my becoming a teacher. I was certain that I would NOT be a teacher when I went to college, and yet, as I got deeper into my education, the thought of sitting in a laboratory doing research became less and less appealing. After some nudging by my mother, I finally gave the education field a longer look and found that I enjoyed, very much, the chance to work with young people and get them excited about how cool science is!

What surprised you about your job when you first started?

The amount of time that I spend on school "stuff."

What disappointed you?

I guess to learn that, as with all professions, there is so much politics involved in school systems.

How has your job changed over time?

My first job was in a tiny school where I taught every science to all the students, from 7th grade to seniors (in addition to coaching). I now only have two different classes to prepare for and every year seems to get a little bit easier as I become more comfortable with my goals and how to reach them.

What will science teachers be doing in ten years?

As our society becomes more and more technologically advanced, I am certain the education students receive will mirror that trend. Biological fields are changing by the hour and the impacts of these discoveries will dramatically change the way we educate our young people. I believe, however, that we MUST NOT become so overwhelmed with the trend that we neglect the basics of the knowledge that got us to this point.

Any advice for students entering high school?

Challenge yourself and take an active role in your education.

How do people react when they learn what you do?

I often get: "Wow, those are really difficult subjects", or "at the high school?" People admire what we do, I think.

Scientist

Alan Adams

Alan Adams is a scientist. Before his promotion, he worked for many years as a lab technician. His employer is a biomedical company that makes heart valve implants. Alan spends his days in the lab, running experiments to learn how best to treat the valves before surgeons put them in patients. These valves not only save lives, they improve the quality of life for the people who receive them. In his work, Alan uses many different kinds of chemicals. Some can be very dangerous so he has to take precautions to keep himself (and the building!) safe. He wears a lab coat, special glasses, and gloves. His best protection, though, is that he knows exactly what he's doing because he understands chemistry.

What exactly do you do

Mainly, I run experiments. I decide how to design the experiment and actually conduct it. In my case, that means analyzing amino acids and testing biochemicals. Next, I analyze the data using statistics and charts and graphs. Then I write reports of the results and present them to coworkers and other scientists.

What's your favorite part of your job?

I like presenting the results to others. I enjoy public speaking, selling ideas--that kind of thing.

Describe some fun times on the job.

There are a lot of fun things to do in a lab when work is slow. Once, when I was first starting out, we filled surgical gloves with helium and wrapped them with surgical tape to create balloons. You can also bounce around magnets or shatter stuff in liquid nitrogen. You can do some pretty interesting things with chemicals if you know what you are doing. You just have to keep everything safe.

Tell a story about problem solving in your job.

One problem with implanting heart valves into a living creature is that calcium builds up and can interfere with the valve's functioning. We treat the valve tissue with chemicals to limit calcification. Before we study the effects of these chemicals in humans, we implant tissue into rats. We take samples overtime and send them off to the lab to see how much calcium has built up. It usually takes three weeks to get the results, but recently, we needed results much faster. We decided to X-ray the rats ourselves, and use a simple calculation to get an estimate in just 24 hours. My supervisor thought of using the X-rays and I figured out how to analyze the results. And it worked!

Any advice for students entering high school?

If you want to have a certain life-style (for example, "live in this kind of house…"), find out about salaries and get the right level of education for the career you want. On the other hand, remember that how much money a job pays isn't as important as doing what you love. Take a wide variety of classes to find out what you're interested in and able to do the best. And don't give up! I failed organic chemistry twice in college before finally something 'clicked' and I earned my degree. Today, I'm a successful chemist.

The Job in Brief...

Title: Scientist

Travel: Rarely, to conferences.

Hours/week: 40

Education: Bachelors of Arts in Biology

Science: I use chemistry and biology all the time. Chemistry tells you what chemicals to mix; biology tells you structures and functions. I have to compare groups of numbers using statistics and use software like Excel, which requires algebra and other math skills. I also have to know what the results mean. If you want to advance, you have to know why you do the procedures you do.

For more information:
www.aaas.org (American Association for the Advancement of Science), www.acs.org (American Chemical Society)

Space Farmer

John Gruener

Vegetables. They have vitamins and minerals that your body needs. They taste good and they're easy to find. But what if you live in the International Space Station, orbiting the earth? You can't run down to the supermarket when you want a tossed salad. And you certainly can't grow your own. Or can you? John Gruener tries to do just that. "I'm a space farmer," he explains. Actually, he's an engineer in the Earth Science and Solar System Exploration Division of NASA. He spends his days growing vegetables without sunlight or soil. It's not easy. Getting the plants to grow is one thing. Getting them to taste good is another (Let's just say that some of his current crop of tomatoes are less than delicious). Fortunately, he loves his work. It combines several of his interests–nature, engineering, science, and food.Based on what he's accomplished so far–the carrots, wheat, tomatoes and others–it's just a matter of time before John's research changes the way astronauts eat in space, and maybe how we eat here on earth.

What exactly do you do?

I develop plant-growth systems so that there can be space farming on the shuttle or the International Space Station. I also study the soil on the moon and Mars to see how it could be used if we built outposts there.

What does a typical day look like?

I'm running experiments, washing lab dishes, and monitoring the plants growing in the lab. Sometimes I prepare presentations to describe the results of my experiments. There's a lot of grunge work doing experiments, but it's balanced by the fun stuff.

What's the coolest part of your job?

Running experiments. I grow plants under different conditions and sometimes I get to eat the vegetables the plants produce.

What's your favorite part?

Working with lots of different scientists and engineers.

How has your job changed over time?

I began by doing grunt work and then my responsibilities increased. I also went from being an engineer to being a scientist by getting more education. Now I occupy the "no man's land" between the two fields.

How do engineers and scientists differ?

Scientists are thinkers who are creative, observant, and like to find explanations for things. Engineers, on the other hand, are builders and like to tinker with things. They tend to be visually-oriented and book-oriented.

Tell a story about problem solving in your job.

The big problem I face is how to grow plants without sunlight or soil, and sometimes without gravity. To solve that problem, we use our special plant growth chambers designed to operate on the shuttle and the International Space Station. Instead of the sun, fluorescent bulbs, light emitting diodes (LEDs), or thin strands of fiber-optic cables provide light. Instead of soil, we use a synthetic substrate (crushed up rocks and minerals), called Zeoponics which I'm helping to develop. Along with water supplied by irrigation tubes, the mineral-rich zeoponic substrate provides the rest of the nutrients that the plants need.

How did you become a space farmer?

My uncle worked at the Johnson Space Center when I was a kid and I got to see some of the Apollo spacecraft being built, so I was always interested in NASA. At the time, I wanted to be a pilot or maybe a park ranger because I also always liked being outdoors. In school, I enjoyed math and science best, though I was a regular guy, grade-wise. Eventually, I decided to become an engineer and got a job at NASA, helping to plan future missions and design spacecraft. After working with the scientists there, I realized how interested I was in science and went back to school and got my Masters in physical science with an emphasis on planetary geology.

What's the next step in your career path?

I could go anywhere. Although there's not much need for space farmers outside of NASA, my education makes me flexible and adaptable. I have skills that can transfer to a number of different areas in science or engineering. It helps that I keep growing intellectually. Even though I finished college, I'm still learning something new every day.

Any advice for students entering high school?

Consider going into a co-op program, where you work while you learn. You can do internships or work in a professor's lab even when you're a freshman in college. And find out about all types of engineering and science before you decide what you want to be.

The Job in Brief...

Title:	Senior Engineer, Earth Science & Solar System Exploration Division	Education:	Bachelors in Aerospace Engineering Masters in Physical Science
Travel:	Not much.	Science:	Daily
Hours:	40 per week	For more information:	http://icnz.lanl.gov

Storm Chaser

David Gold

"Most people have never seen a tornado," says David Gold. "They're much rarer than the news or the movies make them seem." But David is not "most people." When a tornado touches down in Texas or a nearby state, David and his crew are probably there.

David is a storm chaser. His company takes people on ten-day "tours" of storms and tornados. Why do people want to see wild, even violent weather? Probably the same reason David does. "The goal isn't to watch things get destroyed. I think storms are pretty," he explains. "I enjoy it. If I didn't, I wouldn't do it."

Like most storm chasers, David is a meteorologist–someone who studies and predicts weather. Driving to storms takes time so storm chasers need to know in advance where the best storms will be. David makes accurate predictions. News crews and filmmakers regularly travel with him because they know that he'll guide them to the storms they want to capture on film.

When we spoke, storm-chasing season, which runs from the end of April until the end of June, was about to begin. In fact, just a few weeks later, his tour group got to see two tornados in southern Oklahoma. Storm lovers get their money's worth with David.

What exactly do you do?

Each tour lasts 10 days and I do them almost back-to-back during the two-month storm season. During the tour, I have three main responsibilities. First, I make a forecast about where a storm is most likely to hit. Second, I get my customers there. I'm responsible for booking hotels, meals, making travel arrangements, driving, and so on. Third, I provide customer service. I watch over the group, making sure we don't lose anyone. I also educate my clients. To me, education is as important as seeing storms. Most of the tourists are ordinary people, from different walks of life who are interested in severe weather. They want to learn so I try to make meteorology understandable to them. I give them useful information they can apply in their own lives. Most of this teaching is verbal because when you're storm chasing, handouts tend to get destroyed!

During the off-season, I make plans and arrangements for the storm season; hiring assistants, booking customers months in advance, updating the website, and handling the finances. I also make deals with media organizations to give them some footage. Last year, for example, an international National Geographic group made a documentary of us, which appeared on British TV.

Describe a typical day of storm chasing.

Looking for tornados is the ultimate goal. We start each day with a forecast made the night before. In the morning, we analyze data and see where our best chance is. I give the group a briefing, explaining our plans. We drive to the region and I refine that forecast throughout the day. We get there early and get the latest data to narrow the area where we think the storm will be. Then we wait. If we're lucky, we get a good show.

What's the coolest part of your job?

Being free on the road and seeing storms.

What's your favorite part?

Helping people realize their dreams. Some people have always wanted to see tornados and other big storms in person and I help them do that.

Describe a funny incident at work.

There are a lot of them. One time, we got stuck in the mud in the middle of nowhere. We had two vans, plus a rental car with reporters in it. We had to wait until some farmers noticed us and pulled us out. It was so bad that the rental car was useless afterwards. Meanwhile, we're in the middle of a storm with tennis ball sized hail falling on us. It was pretty funny.

And a couple of times, in both 1998 and 1999, we had customers who made noises that attracted a huge herd of cattle in a nearby field. Both times the cattle tried to jump the fence to get to the noisemakers. It was hilarious.

Tell a story about problem solving in your job.

Problems happen all the time. Last year we hit a deer with a severe storm bearing down on us. The bumper on the van smashed into the left front tire and we didn't have a crowbar to pull it off. Instead, we had to use what we had–a tire jack, brute strength and our brains–to figure out how to get it back into usable condition.

How did you become a storm chaser?

I've always been interested in weather. The first thing I did when I got to college was to go to the Meteorology department and ask the grad students to take me storm chasing. I also went to the National Severe Storms Lab weather service and begged for an internship (an unpaid job), which I got.

What do you wish you knew in high school?

I wish I'd understood the importance of building a sound foundation in the basics in all subjects. In college, no one is going to walk you through the basic Trigonometry you should've learned in high school. I took a lot of math and science classes in high school but I didn't work up to my potential. I had to make up a lot of it later. That's why it's important to really understand your homework.

It isn't easy. You have to work very hard. You get out of it what you put into it. But the harder you work, the more you change yourself. If you want to be good at what you do, you have to put time into it, no matter how naturally gifted you are. And if you mess around in high school and college, you can't advance further.

The Job in Brief...

Title:	Storm Chaser
Travel:	I average about 600 miles a day during the storm season.
Hours:	50-60 (year-round)
Education:	Bachelors & Masters in Meteorology Science & Math
Science:	Math and science are crucial. Math is a system of rules that lets you manipulate the basic physical laws of science. It's like building a house. Science is the boards and the bricks. Math is the saw and nails that shape and hold the basic materials together.

For more information go to: www.nws.noaa.gov (National Weather Service)

Welder

Tim Harris

Welding is a universally accepted practice to permanently join metal building materials in today's construction.Welders plan work from drawings or a set of detailed blue prints. Welders perform manual welding in which they entirely control the work or they can do semiautomatic welding, in which they use machinery to help perform some tasks. There are several types of welding for several different purposes and different types of building materials. Oxyacetylene welding uses a mixture of gasses, arc-welding uses sticks of welding material with electricity, and wire welding uses spools of wire with electricity. Welders also repair broken or cracked metal parts. They sometimes fill holes and seams in metal products. When a job is done, they chip or grind off excess weld or solder, using hand or power tools. Welders also examine their work to be sure it meets requirements. Sometimes this even requires the use of small x-ray machines so that the internal strength of the weld can be inspected. Welders primarily work indoors but outdoor work is becoming more common with the larger and taller buildings of today. Their work requires much attention to detail and must allow the pace of their work to be determined by the speed of their equipment.

How did you become welder?

After I graduated from high school, I enlisted in the U.S. Navy for four years of service. After the Navy, I attended a welding school, then was hired as an apprentice welder for the Asarco Smelter. I was put into fabrication and repair, which meant that I was responsible for fixing and repairing all of the heavy equipment around the plant.

What do you enjoy most about your job?

I enjoy the fact that I work 40 hours each week and never have to worry about my job on my time off. I also enjoy the fact that most welders belong to unions that pay for the employee's development and certification programs.

Is science important in the welding industry?

Science is crucial to understanding the basics of welding. There is a lot of science behind the strength of different metals and their chemical compositions. Basic math and trigonometry are also important when it comes to making correct design and dimension measurements. Geometry is also important; understanding how to measure closed and open angles and calculate distances is key to success in this career.

How will welding and the workplace be different 10 years from now?

Future welders will have a safer work environment in the next ten years. There have been many advances in safety equipment that they use in the workplace. New equipment has been manufactured to protect welders from noxious gases, better eye equipment to protect from damaging rays that are given off from welding, more emphasis has been placed on proper lifting techniques.

Branches of Science*

The Earth Sciences

The earth sciences examine the structure and composition of our planet, and the physical processes that have helped to shape it.

Climatology:
The study of climates and investigations of its phenomena and causes.

Geology:
The science of the origin, history, and structure of the Earth, and the physical, chemical, and biological changes that it has experienced or is experiencing.

Meterology:
The science that deals with the atmosphere and its phenomena, such as weather and climate.

Minerology:
The study of the chemistry, crystal structure, and physical (including optical) properties of minerals.

Oceanography:
The exploration and study of the ocean.

Paleontology:
The science of the forms of life that existed in prehistoric or geologic periods.

Seismology:
The study of earthquakes and the movement of waves through the Earth.

The Life Sciences

The life sciences, aka Biology, is the general study of the origin, development, structure, function, evolution, and distribution of living things.

Anatomy:
The study of the structure and organization of living things.

Biochemistry:
The study of the chemistry of compounds and processes occurring in organisms.

Botany:
The study of plants.

Ecology:
The study of how organisms interact with each other and their environment.

Entomology:
The study of insects.

Genetics:
The study of heredity.

Medicine:
The science of diagnosing, treating, and preventing illness, disease, and injury.

Microbiology:
The study of microorganisms, including viruses, prokaryotes and simple eukaryotes.

Zoology:
The science that covers animals and animal life.

The Physical Sciences

The physical sciences investigate the nature and behavior of matter and energy on a vast range of size and scale. In physics itself, scientists study the relationships between matter, energy, force, and time in an attempt to explain how these factors shape the physical behavior of the universe.

Astronomy:
The study of the universe beyond the Earth's atmosphere.

Physics:
The study of matter and energy and the interactions between them. Physicists study such subjects as gravity, light, and time.

Chemistry:
The science that deals with the composition, properties, reactions, and the structure of matter.

*This is not intended to be a comprehensive list of all the branches of science. The definitions listed here are from www.educationoasis.com and www.human-evolution.org.

Biologists, Frogs, and Probability

Some biologists are responsible for finding the cause of declining populations of animal species. When researching infectious diseases the biologists become the equivalent of crime scene investigators. An example of this happened in the high altitude lakes in California's Sierra Nevada. The yellow-legged frog population had declined rapidly to the point that it was put on the endangered species list. Biologists from the University of California at Berkeley were tasked with unravelling the mystery.

Several possible causes were examined such as disease, increased UV radiation, and predation by introduced species. They removed introduced trout from five of the lakes and found that after three years, the population of frogs went back to normal levels. As a result of these findings, the National Park Service and the California Department of Fish and Game removed trout from high altitude lakes. In Montana, the introduction of non-native fish into lakes has had an adverse effect on native fish populations as well. It is the job of wildlife biologists to monitor populations of native and non-native fish.

The following activity shows how the spread of an infectious disease can be calculated.

A family on vacation in Montana found a frog on the banks of the Yellowstone River. The parents were unaware that their youngest son had picked up the frog and put it in an empty cooler. When unpacking the car at Glacier National Park, the parents found the frog in the cooler. They had their son release the frog by Lake McDonald. The frog has an infectious disease. The lake has five other frogs living in it that are all vulnerable to the disease. The infectious disease has a one-day infectious period, and after that, the frog is immune. The new frog randomly visits one of the local frogs during his infectious period. The visited frog has not had the disease before. He gets it and is infectious the following day. He then randomly visits another frog during his infectious period. The disease is transmitted until an infectious frog visits an immune frog, and the disease dies out. There is one frog visit per day. Assuming this pattern, what is the probability that:

2 frogs get the disease _____

3 frogs get the disease _____

4 frogs get the disease _____

5 frogs get the disease _____

6 frogs get the disease _____

(Answers on Page 35)

Food Safety
It Adds Up

Montanans are pretty familiar with the hazards of lead, especially as they relate to mining and smelting. Lead paint received a lot of attention when evidence showed a relationship between lead poisoning in children and lead paint used in buildings built before the mid 1970s. However, for some parts of the country, children are at grave risk for lead poisoning from an unlikely source, candy. This candy is manufactured in Mexico and is easy to purchase in states that border Mexico, but can be found in about any state. The Orange County Register did an investigation of the dangers of lead in candy from Mexico which was published in a 6 part series in 2004. The report is a good example of some of the different uses of science in protecting the health and welfare of the citizens of this country and the challenges of tracking the sources of those threats. The entire report can be found at: www.ocregister.com/investigations/2004/lead/index.php

In the United States, one of the most current examples of tracking health hazards was the ecoli outbreak from eating tainted spinach. For this activity, we will look at how minute levels of lead can quickly lead to toxic levels.

Lead poisoning is officially defined in children as an elevated blood-lead level of 10 micrograms or higher. Level of concern is a term used by officials to describe the point at which the amount of lead in candy exceeds accepted standards. The level of concern for California (in the OC Register report) is 0.2 parts per million lead. A microgram is one-millionth of a gram. Parts per million is the measurement that indicates how many micrograms of lead there are for every million micrograms of candy. In California the unsafe lead levels in a standard size (30 grams) candy is 0.2 parts per million and above.

Listed below is an example of a fictional report done on samples of Mexican candy. Use the data from the report to answer questions that follow. Notice that some of the samples were the wrappers that the candy came in. Wrappers must register 600 ppm lead before considered toxic. The last five samples are of tamarind candy that is typically sold in tiny clay pots.

Sample Number	Result
1	< .2 ppm
2	< .2 ppm
3	< .2 ppm
4A	< .2 ppm
4B (wrapper)	4 ppm
5A	< .2 ppm
5B (wrapper)	.6 ppm
6	< .2 ppm
7	< .2 ppm
8	< .2 ppm
9A	< .2 ppm
9B (wrapper)	2.2 ppm
10A	< .2 ppm
10B (wrapper)	1.2 ppm
11	< .2 ppm
12	< .2 ppm
13	< .2 ppm
14	< .2 ppm
15	< .2 ppm
16	< .2 ppm
17	1.2 ppm
18	< .2 ppm
19	< .2 ppm
20	< .2 ppm
21	.8 ppm
22A	.4 ppm
22B (wrapper)	900 ppm
23A	< .2 ppm
23B (wrapper)	600 ppm
24	.5 ppm
25A	< .2 ppm
25B (wrapper)	2.6 ppm
26A	.2 ppm
26B (wrapper)	7 ppm
27	< .2 ppm
28A	< .2 ppm
28B (wrapper)	1.0 ppm
29A	< .2 ppm
29B (wrapper)	1.0 ppm
30	< .2 ppm
31	.3 ppm
32	.2 ppm
33	100 ppm
34	30 ppm
35	30 ppm

1. Based on the data, how many samples were submitted?
2. How many candy samples contained .2 ppm or more of lead?
3. How many wrapper samples contained at least 600 ppm of lead?
4. What percent of the samples would be considered unsafe by the California standards?
5. Which candy sample appears to have the greatest risk of causing lead poisoning?

(Answers on Page 36)

The Case of the Purloined Plant

In 1995, horticulturists from the Royal Botanic Garden Edinburgh (RBGE) discovered the blood-red Rhododendron tuhanensis, one of the rarest plants on earth, during an expedition to the slopes of Mount Kinabalu in Borneo. The team took cuttings from that plant and brought them back to the Scottish capital, where they grew into mature plants. In a follow-up trip to the same area one year later, they found no sign of the plant. The plants now housed at the RBGE are the only surviving specimens.

This rare plant is the subject of this activity. The above account is real, the story appeared in the January 11, 2007 Scotsman News. The rest of the story below is fiction.

On January 15th, Nathan Naples, horticulturist for the Denver Botanic Gardens, read the news about the Rhododendron tuhanensis. He went to the director of the Gardens, Sabrina Avatar, to discuss a possible visit to the RBGE to see this rare plant and share in a discussion about conservation efforts at the Denver Botanic Gardens. Sabrina agreed that this trip would be a great idea and had her secretary put the trip together for herself, Nathan, and summer intern, Tony Champas.

On February 5th, the team arrived in Edinburgh and was met by the director of the RBGE, Clark McNab, dressed in a traditional Scottish kilt. Clark took the group to his office at the RBGE. They spoke at length about the discovery of the Rhododendron tuhanesis and their success in growing several mature plants out of the cuttings they brought back from Borneo. He told them that when they had a sufficient number of mature plants they planned on reintroducing them back in their native environment and monitoring them to see if they survive or not. Sabrina discussed the conservation efforts currently underway at the Denver Botanic Gardens. Clark then took the group on a tour of the RBGE. The evening before the team went back to Denver, Clark held a small reception for them in his office.

Several days after the American team arrived back in Denver, they were met at the Denver Botanic Gardens by the FBI and local law enforcement officers. It appeared that one of the Rhododendron plants disappeared sometime during their visit to the RBGE and they suspected one of the Americans took the plant.

Sabrina was appalled that the RGBE would think they had stolen the plant. Nathan was concerned that someone with no respect for the importance of this rare plant would end up killing it and ruining the efforts to restore the plant to the wild. Tony didn't say much at all, he needed to complete the internship in order to finish his master's degree. He didn't want to bring undue attention to himself. The FBI along with the Scottish authorities collected evidence from the scene and took statements from all of the individuals in Denver and in Scotland. Here are some of their findings:

From the Scotland investigation

Clark McNab had been the director of the RGBE since 1990 and was not one of the individuals on the first trip to Borneo. As director of the RGBE, he took great pride in having this rare find; however, he resented the fact that he did not get credit for the discovery. He had one of the plants in his office on a stand in the corner of the room.

On the plant stand, investigators collected several pieces of evidence. A blue fiber, some soil, and a white powder. Results from the tests on each item showed that the fiber was blue silk commonly found in neckties, the soil was the same soil that all of the Rhododendron cuttings were placed in. The white powder was powdered sugar.

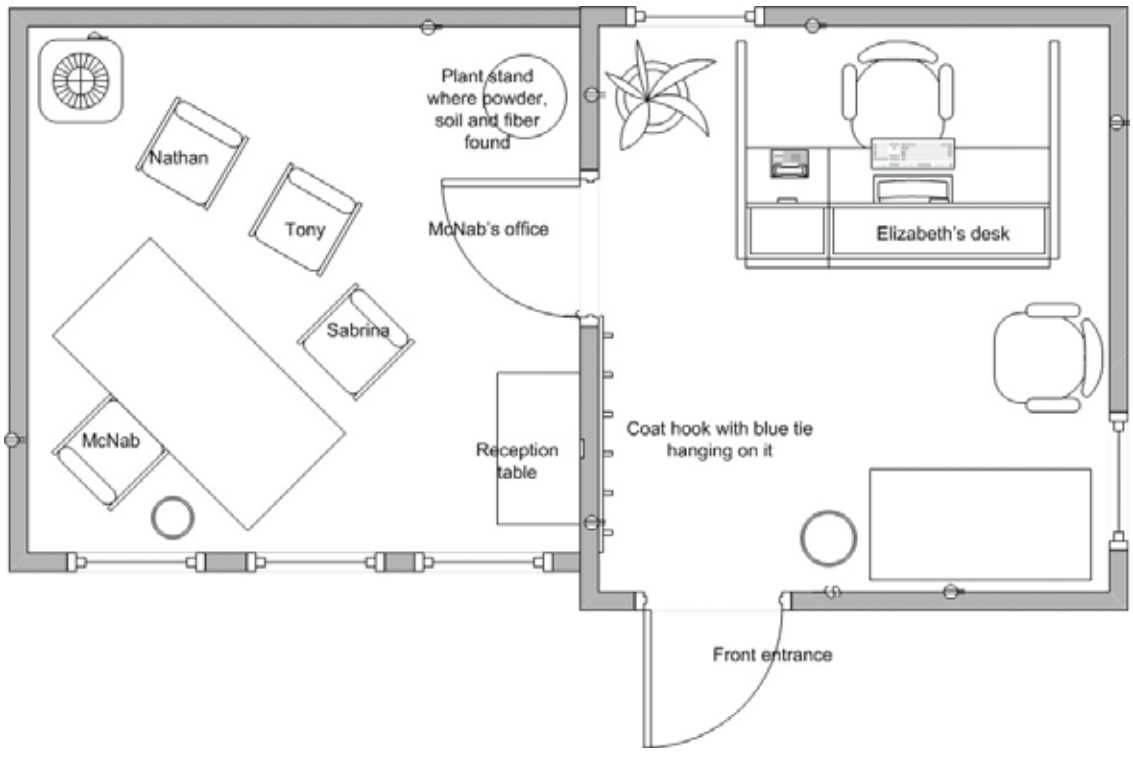
Clark said that he was never alone in the room during the visit with the Americans.

There had been a small reception for the Americans in Clark's office the evening before they left. He could not remember what food they were served but did remember serving Deuchars IPA from the Caledonian Brewery in Edinburgh. Clark's secretary, Elizabeth MacCaskill, was in charge of making the arrangements for the reception. Clark said she put together a fine display of Scottish treats, and that his favorite was the shortbread.

Clark went home immediately after the reception and left Elizabeth to tidy up the office.

Elizabeth made the arrangements for the reception which included some Scottish delicacies such as Scotch Shortbread which is made with powdered sugar. She wanted the Americans to have some authentic Scottish treats. She set up the drinks and pastries on the table near the door. She didn't remember if the rare plant was there at that time or not, since its stand is actually behind the door when the door is opened.

After the reception was over, she cleaned up Clark's office, threw away the napkins etc., shut off the lights and locked the door behind her. She returned to the



office late in the morning the next day. She had taken the Americans to the airport that morning, and then had run a few errands before coming into the office. When she got back to the office she noticed that the plant was missing. She said Clark was not in the office when she got there. She notified the authorities immediately.

When Clark was questioned about where he was on the morning the Americans left, he said that he slept in that morning due to a head cold. He showed up to the office around 1:00 in the afternoon. He was wearing a blue pinstripe suit, with a vest, and a white shirt.

From the Denver investigation

Sabrina said that none of the team had been alone in Director McNab's office at any time. She said that Elizabeth MacCaskill drove the three of them to the airport and helped them with their luggage. She also stated that they had to go through customs when they entered the United States. There would be no way to slip a plant of that size through customs. When asked what she wore during her trip she said she wore a silk dress and jacket. She had taken the dress to the dry cleaners as soon as they returned.

The FBI picked up the dress and jacket at the dry cleaners and noted that the dress was a multi-colored floral pattern.

When asked what she ate at the reception, Sabrina said she sampled the IPA but did not have any of the shortbread because she has a wheat allergy.

Both Nathan and Tony said they had the IPA and ate at least one of each type of pastry on the tray. Neither Nathan nor Tony wore anything silk or blue. They stated that neither had been alone in McNab's office during the visit.

The officers felt Tony was hiding something so pressed him further. Tony said he was completing the internship as part of his master's program and was nervous about being accused of stealing the plant. He admitted that he was in possession of a leaf from the plant that disappeared. He produced the leaf enclosed in an airtight container about the size of a business card. He wanted to include drawings of the leaf with his thesis and needed a leaf to look at to make the drawings.

Questions:

Is there enough evidence to make a conclusion?

What additional evidence would you like to find?

What information makes you come to that conclusion?

Given the above evidence whom do you think stole the plant?

Contouring and Topo Maps

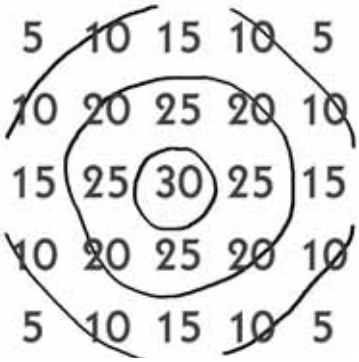
Contouring is drawing lines through an array of numbers that connect points of equal value. There are many uses for contouring in the world of work such as weather forecasting, making maps, and flying to name a few. In this activity, we will focus on two types of contouring, isotherms and topography.

In the example 1 below there is an array of numbers representing a small piece of geography. Trying to picture what these numbers represent is hard to do until contouring is used. In example 2 the contour lines of the same value (the contour interval (the spacing between the lines) is 10 in this example). Notice how you can see the top of the hill with the sloping sides.

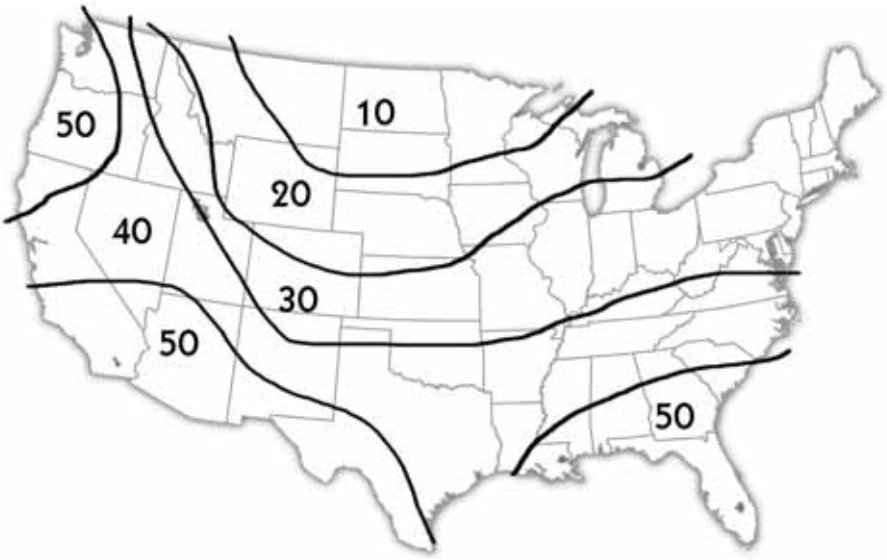
Example 1

5	10	15	10	5
10	20	25	20	10
15	25	30	25	15
10	20	25	20	10
5	10	15	10	5

Example 2



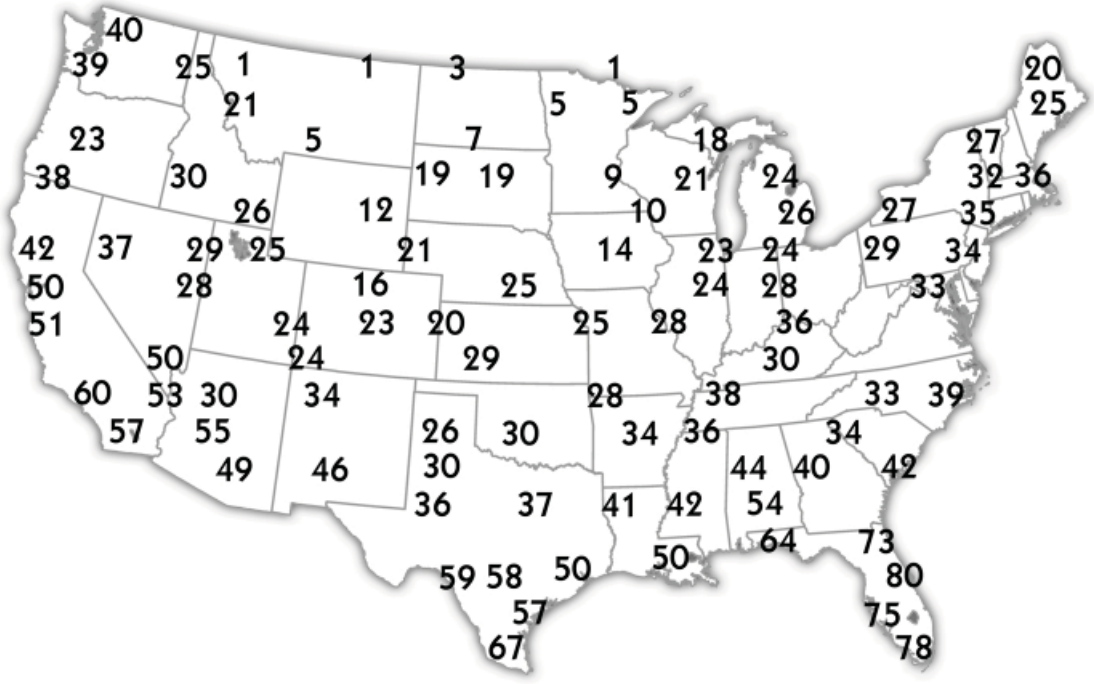
Many people see the following type of map when watching the weather on TV. The map below shows isotherms. An isotherm is a line connecting locations with equal temperature. They are typically seen in intervals of 10 degrees Fahrenheit in the United States.



Exercise #1 - Draw the contour lines in intervals of 10.

10	12	16	20	22	25	30	32	35	40	35	35	37	30	30	28	30	25
10	15	20	25	30	30	34	35	38	40	40	37	35	30	25	24	24	25
14	20	22	25	28	30	35	38	40	45	40	35	30	28	25	25	28	25
15	15	20	25	30	32	35	40	35	35	33	30	28	22	18	15	15	12
15	15	18	20	25	30	35	40	35	35	33	30	28	22	18	15	15	12
10	12	15	20	22	25	28	30	28	25	22	20	18	16	15	14	13	12
10	15	18	20	25	28	30	32	35	30	28	25	18	18	16	15	14	12
14	18	20	22	25	30	32	35	38	32	28	22	20	18	16	15	15	15
18	22	25	30	32	35	40	38	33	30	27	25	22	18	5	15	15	15
19	25	28	32	36	40	35	32	28	25	23	20	18	15	12	12	10	10
20	28	30	35	42	38	35	30	27	25	20	20	18	15	12	10	10	10
25	30	38	42	50	45	40	30	27	22	18	18	18	15	12	10	10	10
25	32	38	45	52	50	45	35	30	25	20	20	18	16	15	12	11	10
28	35	40	48	52	48	43	38	35	30	25	20	18	16	15	15	12	12
28	32	38	42	45	45	40	38	35	30	25	20	18	18	16	16	15	14
25	30	35	35	38	35	32	30	28	25	22	20	20	18	16	16	16	15
20	28	32	35	33	30	28	25	24	22	20	18	18	16	16	16	16	16
18	20	25	30	25	23	22	20	20	18	18	17	16	16	16	16	16	16

Exercise #2 – Draw the isotherms in intervals of 10 degrees on the map



(Answers on Page 36)

Answer to:

Biologists, Frogs, and Probability

To solve the problem, we will create a probability tree, labelling the frogs A, B, C, D, E, and F. Frog A is the infected, non-native frog.

Day One:

During its one-day infectious period, Frog A will visit one other frog. Since none of the native frogs are immune, the probability that Frog A will infect a second frog is 1. Let's assume that this second frog is Frog B.

Day Two:

There is a 1 in 5 chance that Frog B will visit any given frog. If Frog B visits the original frog (A), which is now immune, the cycle of infection will end and a total of two frogs will get the disease. Therefore, the probability that two frogs will be infected is 1/5. However, the chances that Frog B will visit a vulnerable frog and continue the cycle of infection is 4/5.

Day Three:

Let's assume that the cycle continues and that Frog C has been infected. Frogs A & B are now immune, while Frogs D, E, & F are vulnerable. This means that the probability of Frog C visiting a vulnerable frog is 3/5, while the probability that it will visit an immune frog (and end the cycle of infection) is 2/5. To figure the probability that three frogs will be affected by the disease, take the 4/5 chance of the disease spreading beyond day two, and multiply it by the 2/5 chance that the cycle will end on day three.

4/5 x 2/5 = 8/25

Day Four:

If the cycle of infection continues, Frog D is now contagious, Frogs A, B, & C are immune, and Frogs E & F are vulnerable. The probability of Frog D visiting a vulnerable frog is now 2/5, while the chance it will visit an immune frog is 3/5. The probability that four frogs will be affected is calculated as follows:

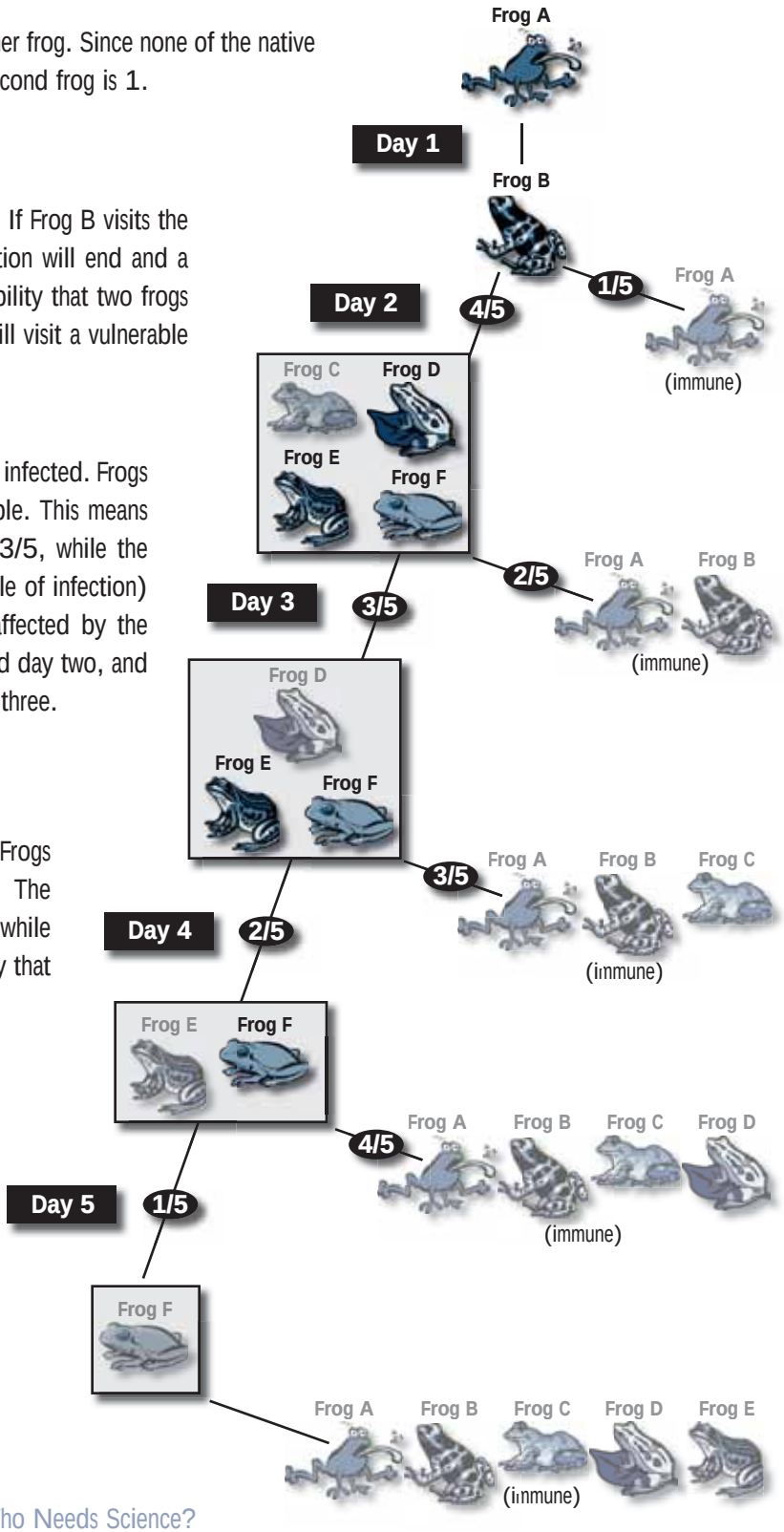
4/5 x 3/5 x 3/5 = 36/125

Day Five:

Following the same pattern, Frog E is now contagious, Frogs A, B, C, & D are immune, and only Frog F is vulnerable. This gives Frog E only a 1/5 chance of infecting the last vulnerable frog, and a 4/5 chance of visiting an immune frog. We can now calculate the probability for the final two scenarios:

Five frogs infected: 4/5 x 3/5 x 2/5 x 4/5 = 96/625

Six frogs infected: 4/5 x 3/5 x 2/5 x 1/5 = 24/625

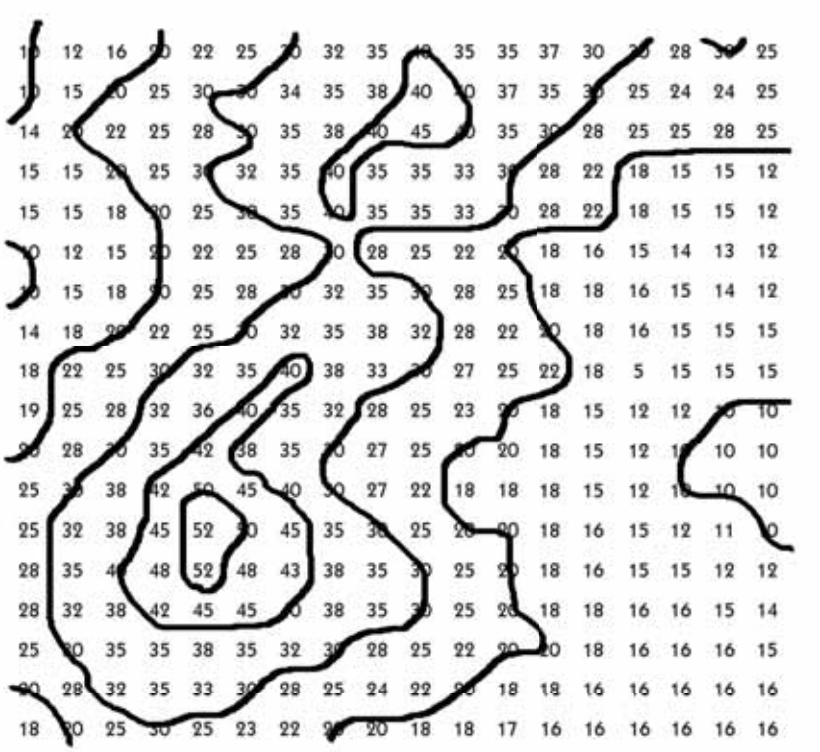


Answers to:
Food Safety: It Adds Up

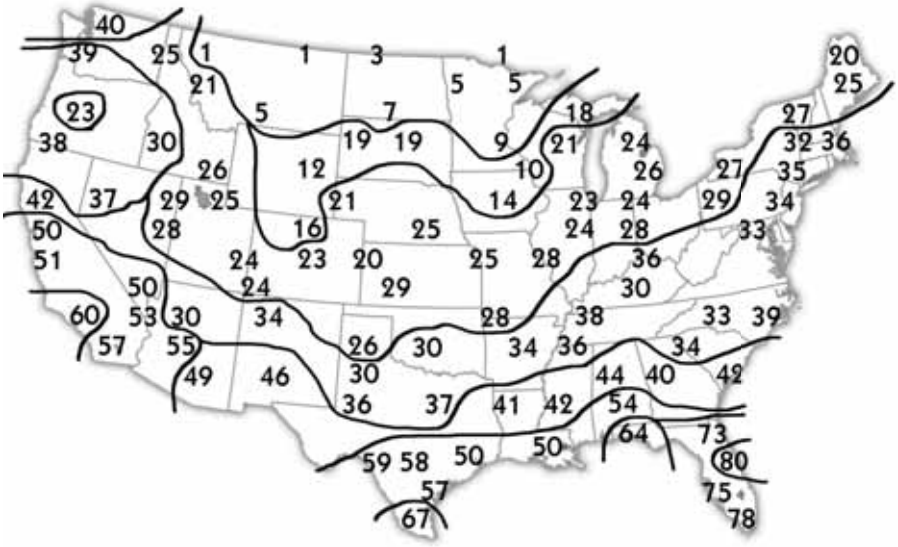
1. **45** 2. **10** 3. **2** 4. **26.6%** 5. **#33**

Answers to:
Contouring and Topo Maps

Solution to Exercise #1



Solution to Exercise #2



MONTANA CAREER RESOURCE NETWORK

What is the Montana Career Resource Network (MCRN)?

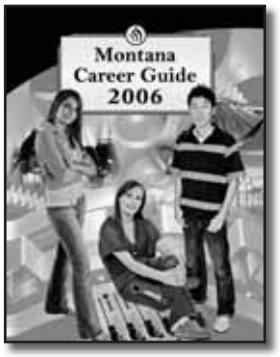
MCRN provides Montanans with career information to help them make smart career decisions. We help students become aware of the world of work, and to understand the connection between education and their future careers.

What kind of information and products does MCRN provide?

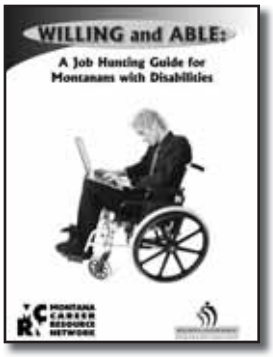
- **Career Development Publications**
- Links to **current job openings** in Montana and the U.S.
- Information on all **2 and 4-year colleges** and universities in the nation, with additional detail on Montana schools
- Detailed **Scholarship & Financial Aid information**, including over $155 million worth of Montana and national scholarships and grants–all researched and verified annually.
- Information on **training options** for any career field.
- 4-8 year **online planners** that are flexible, interactive, and adaptable as students progress or state requirements change.
- **MCIS - Montana's Career Information System**: the internet-based career exploration tool that lets user research hundreds of occupations, take interest and skills assessments, and take practice tests such as the ACT, SAT, GED, Civil Service tests (Police Officer, Firefighter, etc.), and more.

Use MCIS at: www.mtcis.intocareers.org Username: visitor Password: visitor06

Also from MCRN:



Montana Career Guide
Our annual guide to over 200 of Montana's top occupations. Includes info on wages, projected openings, and more. Also includes articles on choosing a training program, gaining work experience, marketing your skills in a resume, interviewing for jobs, and more



Willing & Able:
A Job Hunting Guide for Montanans with Disabilities

This guide informs readers of their rights under the Americans with Disabilities Act, lists helpful resources and agencies, and provides tips on searching for jobs, writing resumes, job interviews, and disclosing disability information.

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